WW: DY Estimation, Met Efficiency and JEC in 38X data/MC

Outline

- List of datasets
- DY estimation for WW
- MET selection efficiencies in WW
- Jet response in 38X data/MC using the Z+1 jet events

Datasets

- Data
    - 15/pb data corresponds to: /afs/cern.ch/user/s/slava77/public/jsons/oct22/special/Cert_TopOct22_Merged_135821-148058_allPVT.txt
- 38X MC for DY estimation and JEC studies
    - /DYToEE_M-20_TuneZ2_7TeV-pythia6_Fall10-START38_V12-v1/
    - /DYToMuMu_M-20_TuneZ2_7TeV-pythia6_Fall10-START38_V12-v1/
- 36X MC for Met efficiency comparisons
    - Pythia: /WWTo2L2Nu_7TeV-pythia6_Spring10-START3X_V26-v1
    - Madgraph: /VVJets-madgraph_Spring10-START3X_V26_S09-v1
    - MC@NLO: /WWtoEE-mcatnlo_Spring10-START3X_V26_S09-v1

DY Estimation

Drell Yan Estimation (1/2)

- We implemented the out/in method in WW looper
- Test the method in the DY without MET cuts

Table 2: Drell-Yan estimation with no MET Cut.

Sample	ee	$\mu\mu$
$R_{out/in}$	$0.09 \pm 0.00 \pm 0.02$	0.10 ± 0.00
MC Prediction	278.58 ± 1.71	425.79 ± 2.06
Data Driven DY Estimate	295.63 ± 5.56	481.32 ± 7.37
Actual Yield in Data	316	491

  - Good agreement is seen

- However, the out/in ratio is sensitive to the MET cut, especially as we apply tight MET cut, the prediction can be statistically limited, leading to large fluctuation

Drell Yan Estimation (2/2)

- The out/in ratio versus the projected MET cut
  - The large deviation at MET cuts statistically limited
- Before we can get a large DY MC, take the conservative approach, use the largest spread of the out/in ratio as the systematic error for the prediction

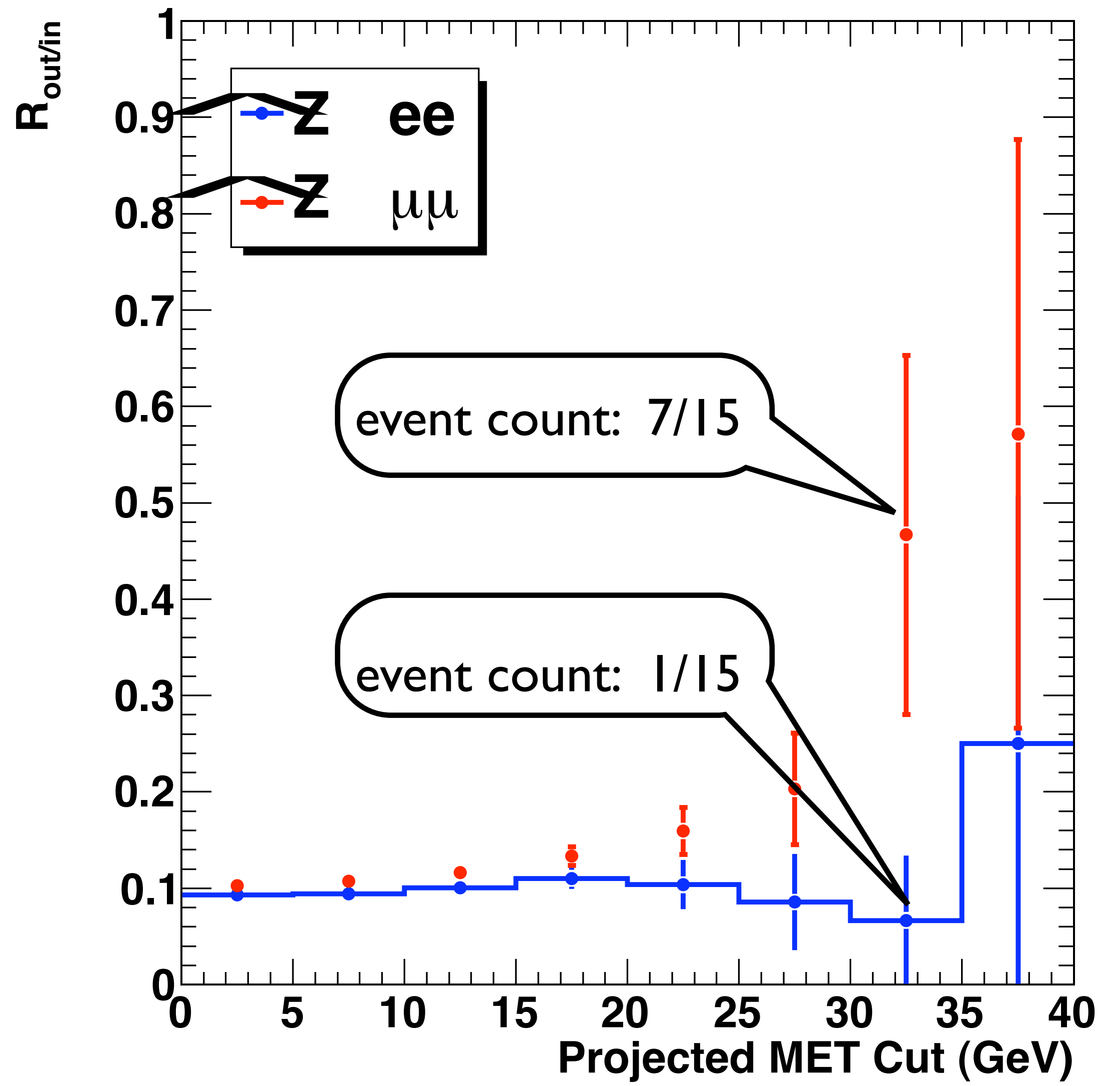


Table 1: Drell-Yan estimation with the nominal MET Cut.

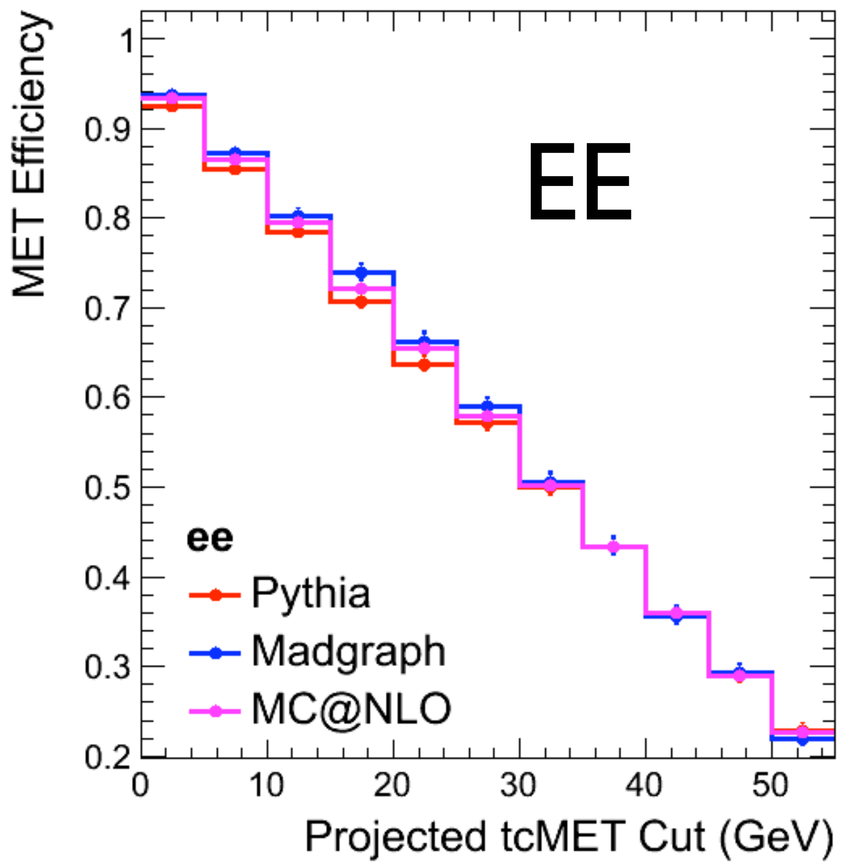
Sample	ee	$\mu\mu$
$R_{out/in}$	$0.07 \pm 0.07 \pm 0.04$	$0.47 \pm 0.18 \pm 0.36$
MC Prediction	0.01 ± 0.01	0.07 ± 0.03
Data Driven DY Estimate	$-0.03 \pm 0.04 \pm 0.03$	$0.18 \pm 0.55 \pm 0.57$
Actual Yield in Data	0	0

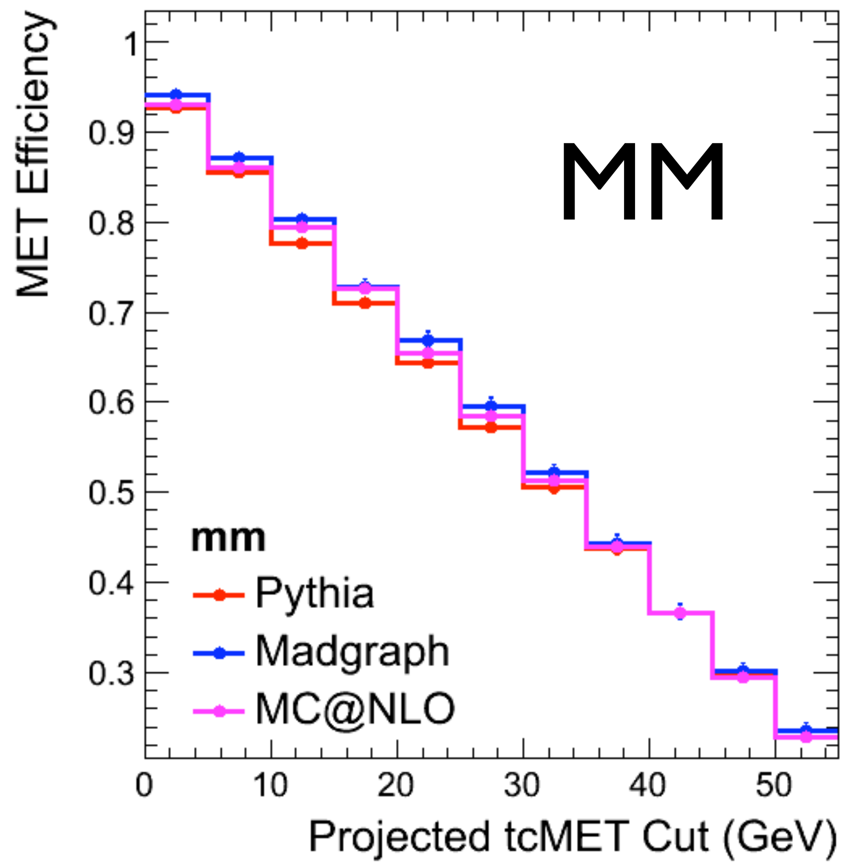
MET Signal Efficiency

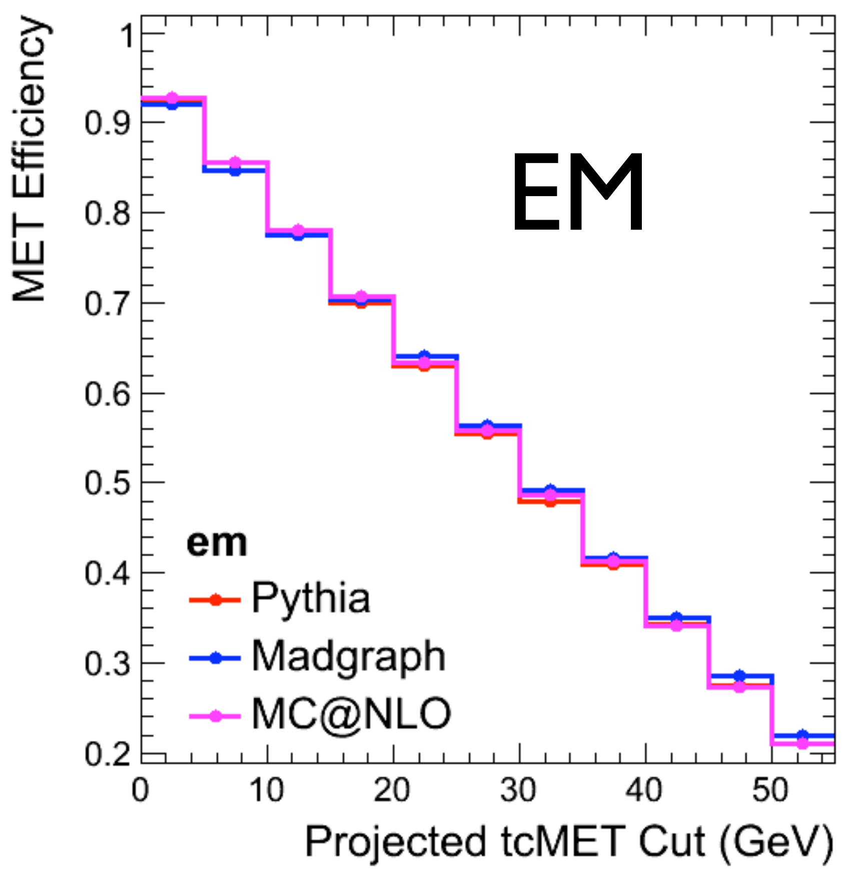
MET Selection Efficiency

- The current selection is based on the projected MET
  - EE/MM: projected MET > 35 GeV
  - EM: projected MET > 20 GeV
- We have to rely purely on the MC for this measurement
  - NLO and beyond effects (done)
    - compare various MC samples
  - Data/MC MET resolution differences in Z-events (done)
  - PU effect in the data (on-going)
    - Embed WW MC with N random MET vectors from MinBias MC
    - MET efficiency vs N vertices, and see the effects

Met Efficiency from MCs



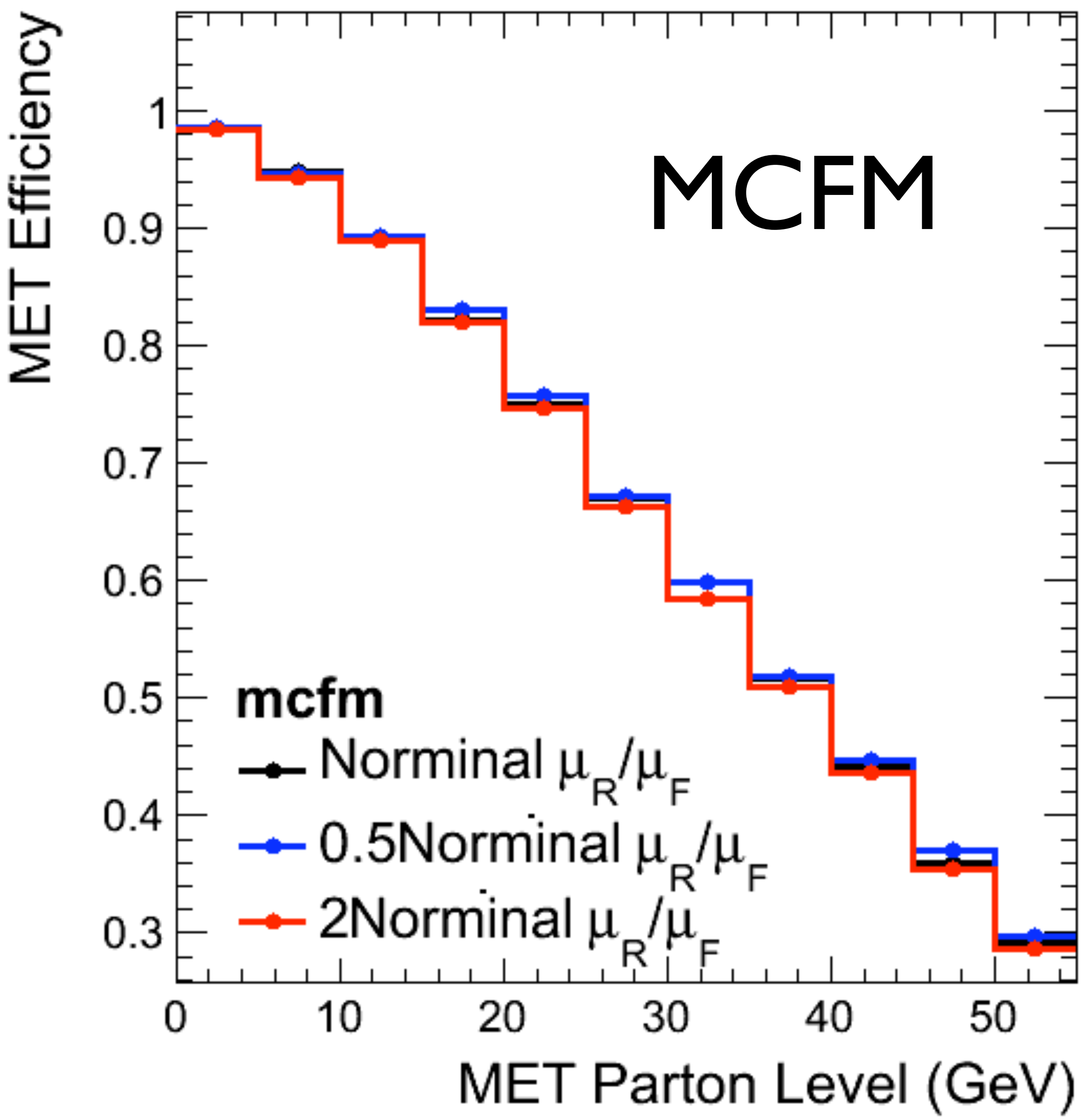




The difference between different MC samples are within 3%

Met Efficiency from MCFM

- This is just a sanity check on the possible theoretical errors
  - The absolute number should not be directly compared with the values based on MC samples
  - Varying the normalization/ factorization scale gives only a hint on the NLO and beyond effects
  - The difference is smaller than what we see in comparing different MC samples
  - This is a confirmation that NLO and beyond effects are not crazy



MET Efficiency

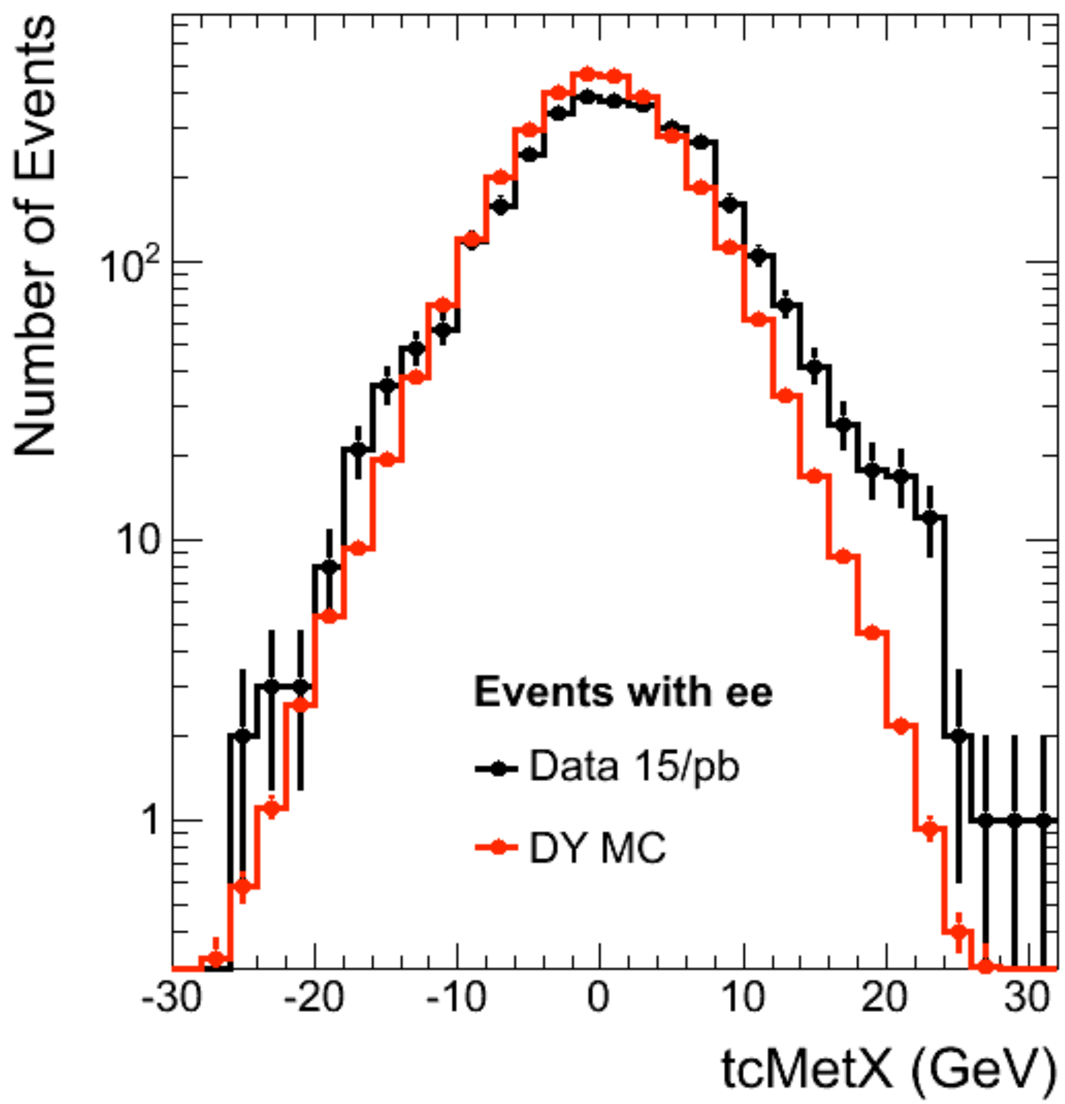
- Some numbers..

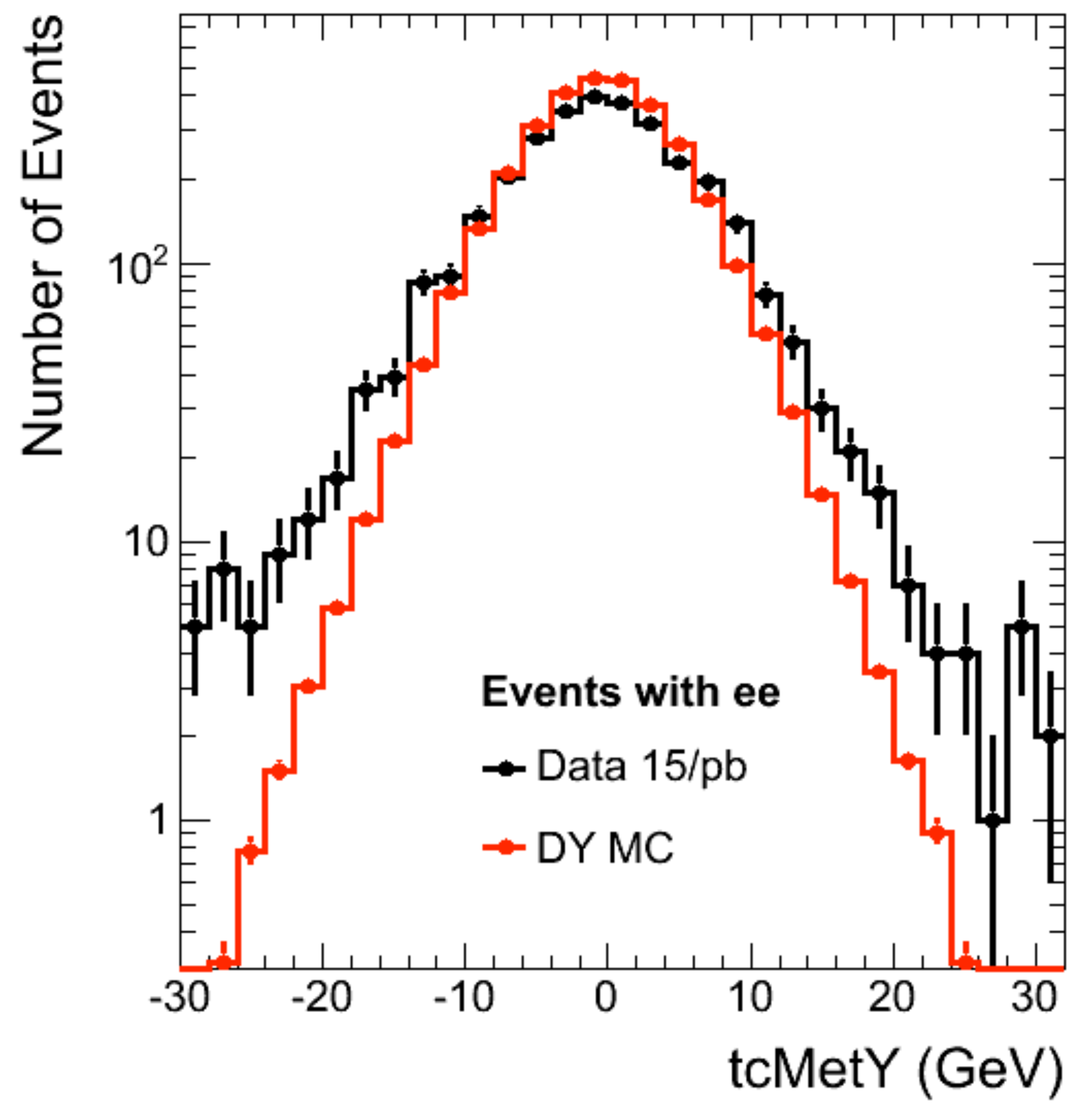
Table 1: Missing energy selection efficiencies. The central value of the MC efficiencies correspond to Pythia MC. While the statistical errors are neglible, the uncertainties quoted for the MC samples are the maximum difference between pythia and Madgraph/MC@NLO. The efficiciency using the parton level MET in MCFM corresponds to the scale choice of $\mu_R = \mu_F = 160$. If we vary the scale by either one half or twice, the resulted differences in the MET efficiencies are quoted in the error.

Projected MET Cut (GeV)	ee (%)	$\mu\mu$ (%)	eμ (%)	mcfm (%)
20	70.7$\pm$ 3.2	71.0$\pm$ 1.7	70.0$\pm$ 0.6	82.2$\pm$ 0.8
30	57.1$\pm$ 1.8	57.3$\pm$ 2.3	55.5$\pm$ 0.8	67.0$\pm$ 0.8
35	50.0$\pm$ 0.6	50.6$\pm$ 1.5	48.0$\pm$ 1.2	58.5$\pm$ 1.3
40	43.4$\pm$ 0.1	43.8$\pm$ 0.6	41.0$\pm$ 0.7	51.6$\pm$ 0.7

MET Resolution using Z Events

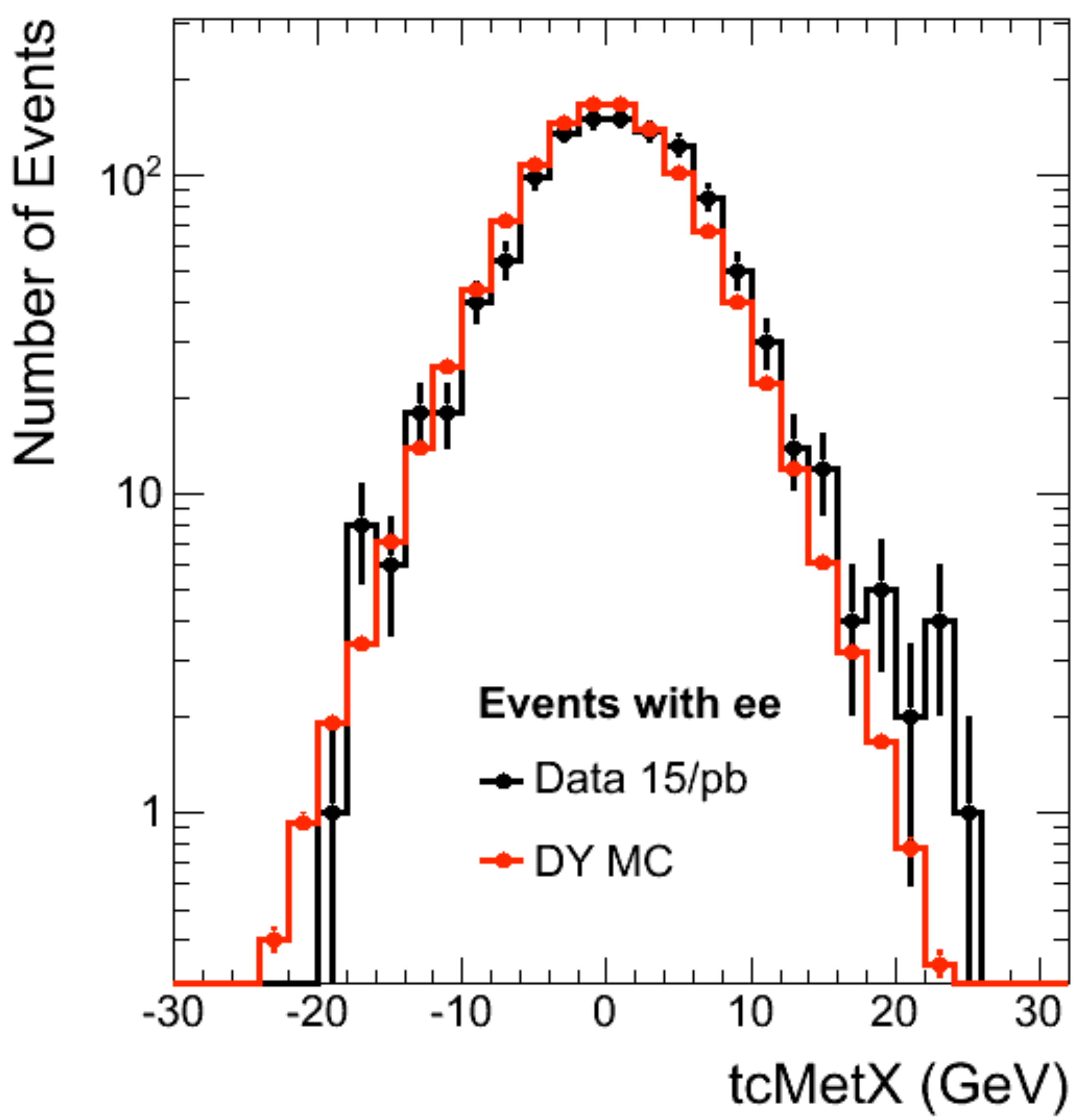
- The resolution in data is wider than in MC, mainly to the PU
  - The data/MC difference introduces more systematic error on MET eff.
  - The PU effects to Z events could be different from the effects on WW
  - Z→μμ results are in backup slides 18-19

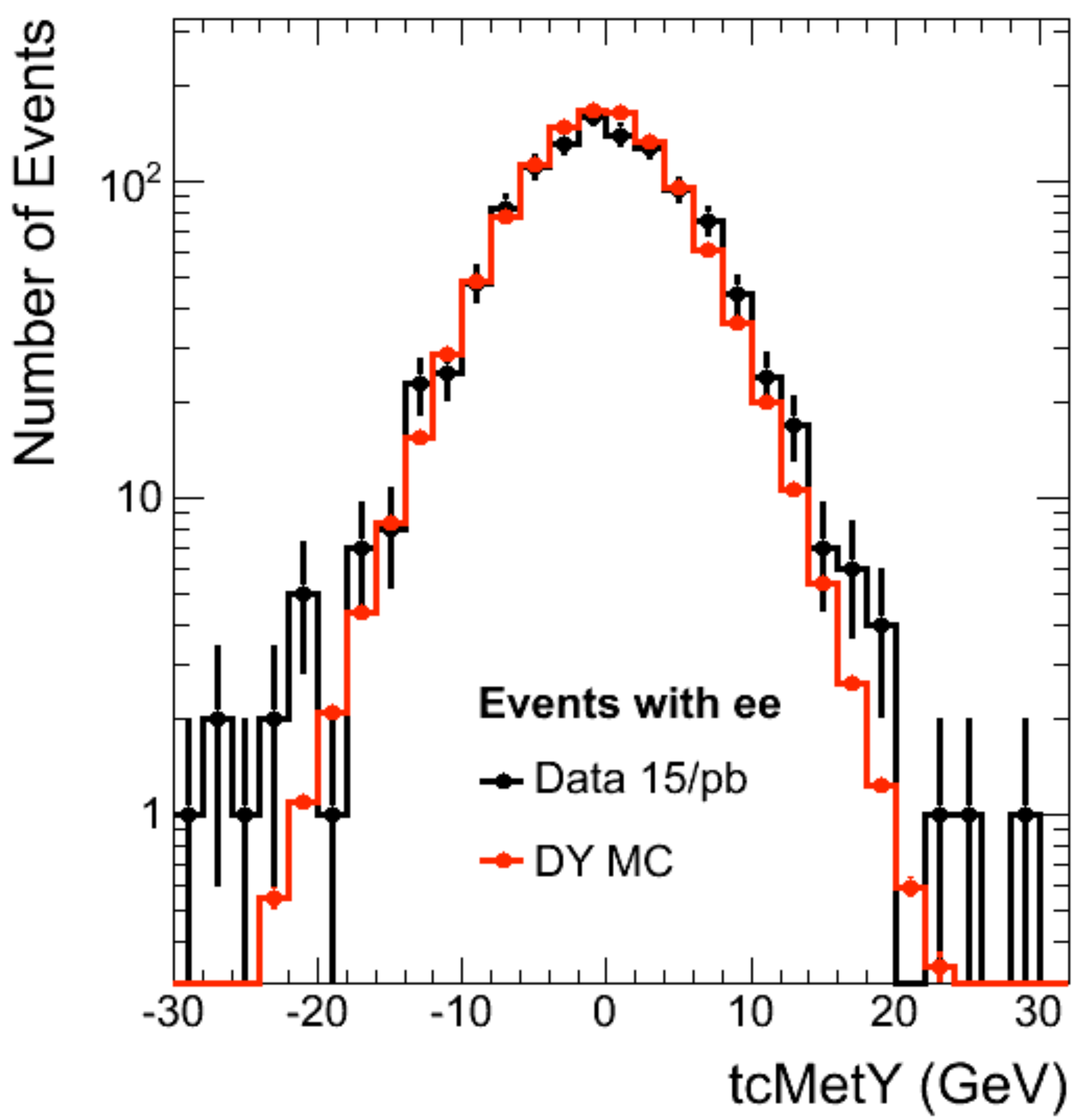




MET Resolution in One-Vertex Case

- Requiring only one good vertex in data
  - The resolution in data agrees much better with MC
  - PU effects are not negligible

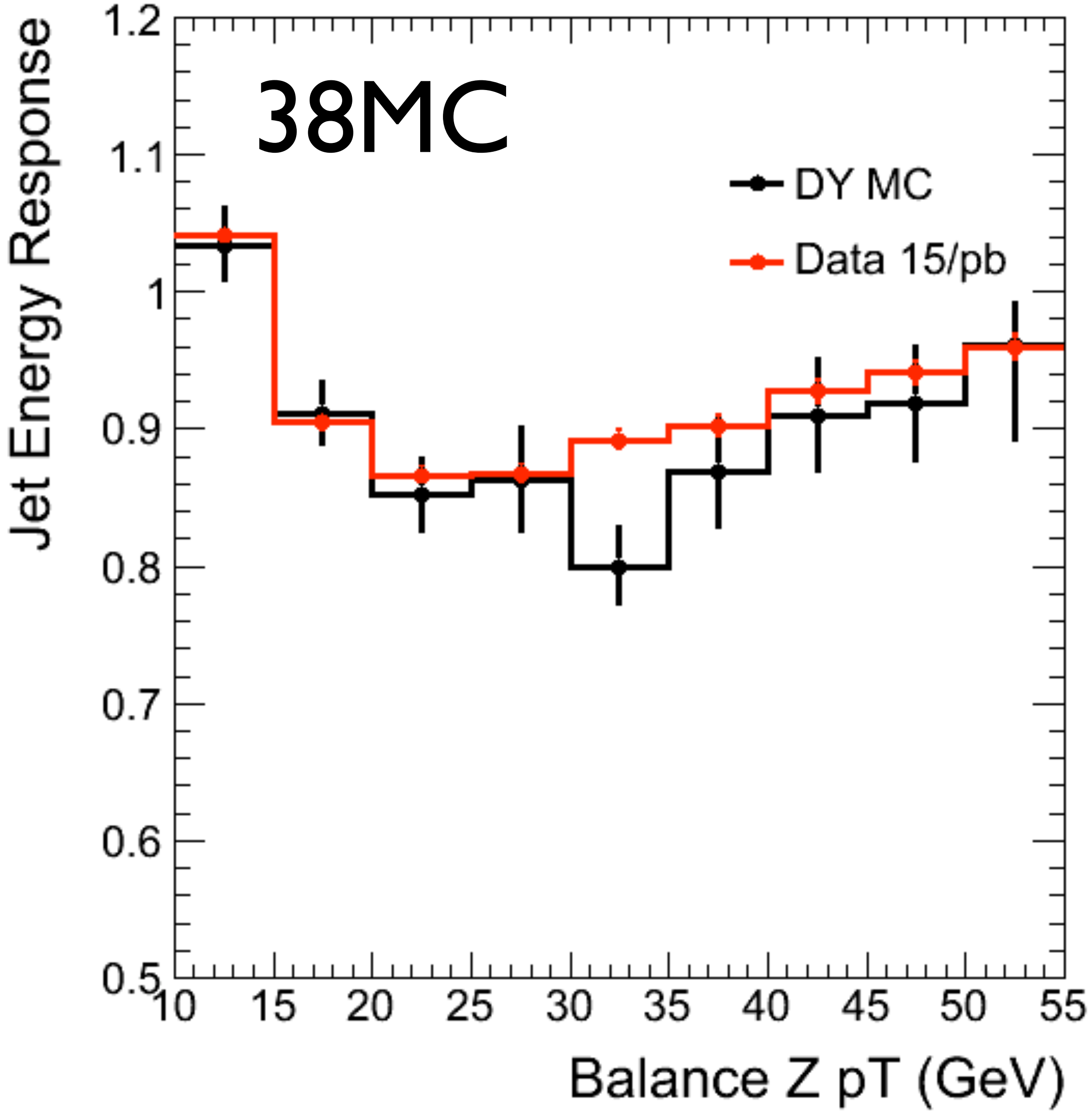


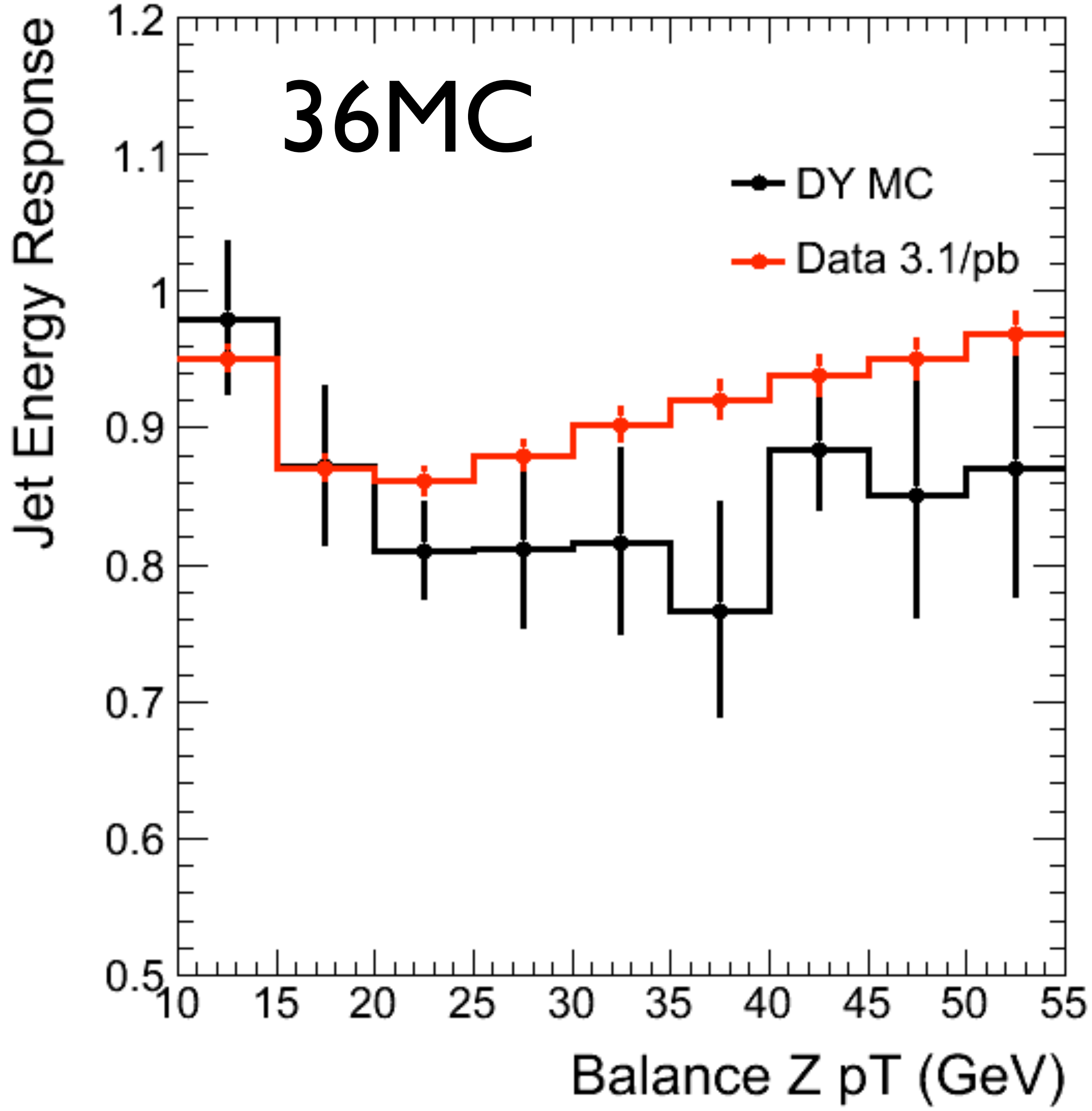


JEC in 38X

JEC in 38X using Z + 1 Jet event

- JEC response: Corrected PFJet pT/ balance Z pT
  - Using 36X corrections on 38X data/MC gives good data/MC agreement
  - Event selections in backup slide 20





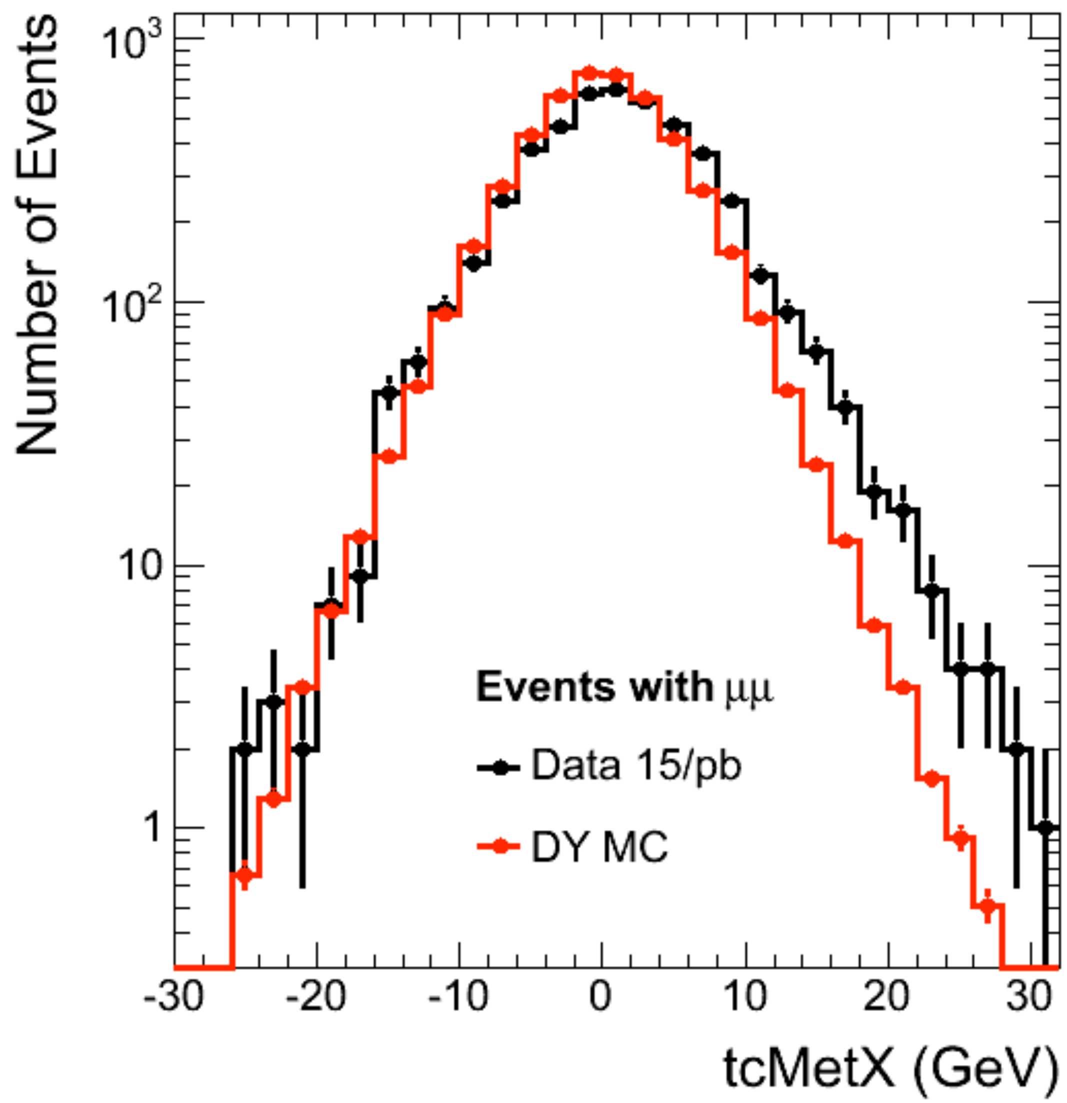
Summary

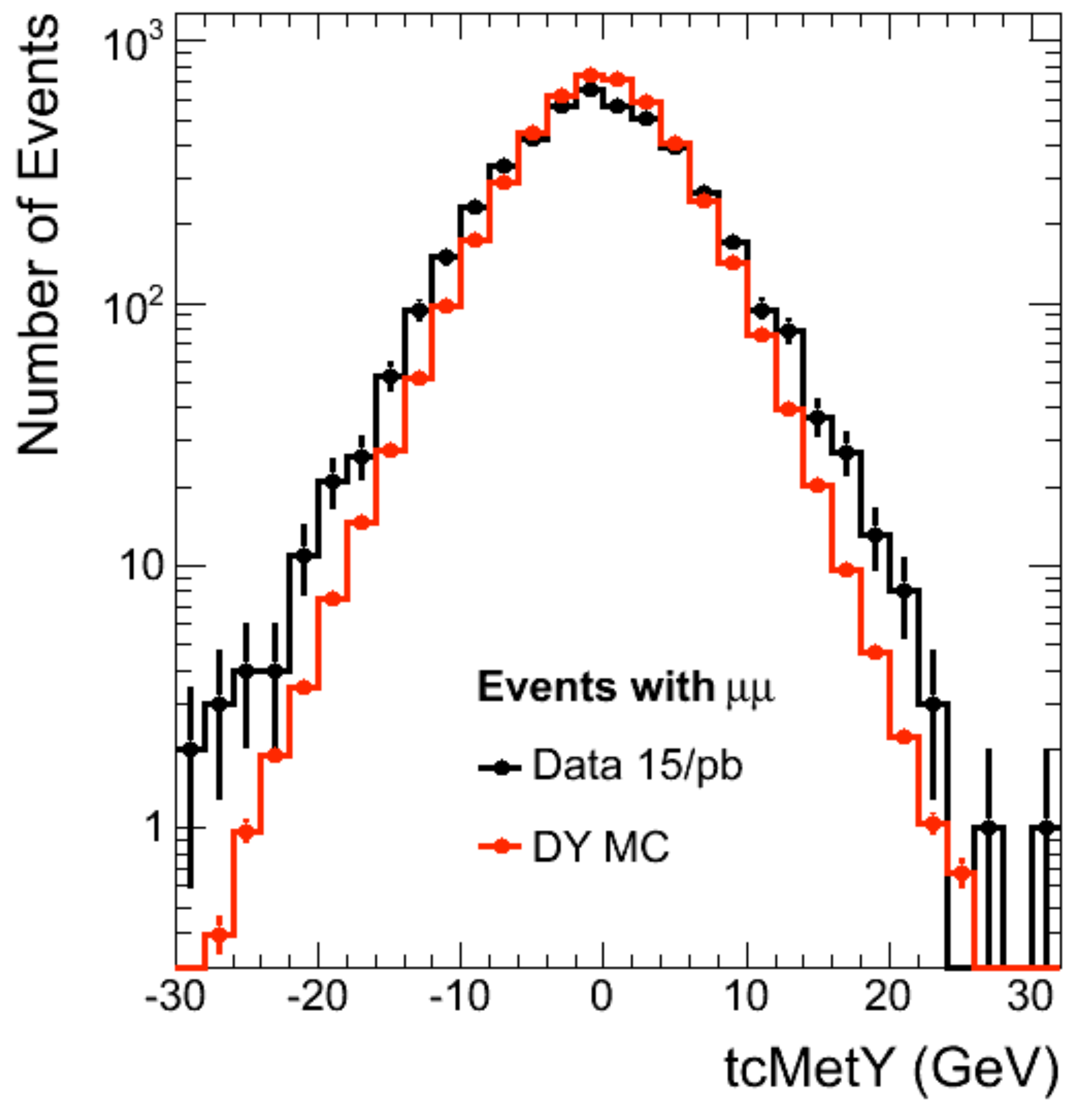
- DY estimation for WW: 0.0±0.0±0.0 (EE) 0.2±0.6±0.6 (MM)
  - The R(out/in) is sensitive to the MET cut.
  - The largest difference in this ratio at different MET cut contribute the dominant systematic error of the estimation in MM
- MET selection efficiencies
  - Differences between Pythia/Madgraph/MC@NLO are within 3%
  - MET resolution (X,Y) are sensitive to the PU, seen in Z events
  - On-going work to convolute the MinBias MET with the WW signal MC to check the PU effects to WW MET efficiency
- Jet response in 38X data/MC using the Z+1 jet events
  - Applying 36X corrections on the 38X data/MC gives good data/MC agreement, using the L2/L3 PF Jets

Backup Slides

MET (x,y) in MM

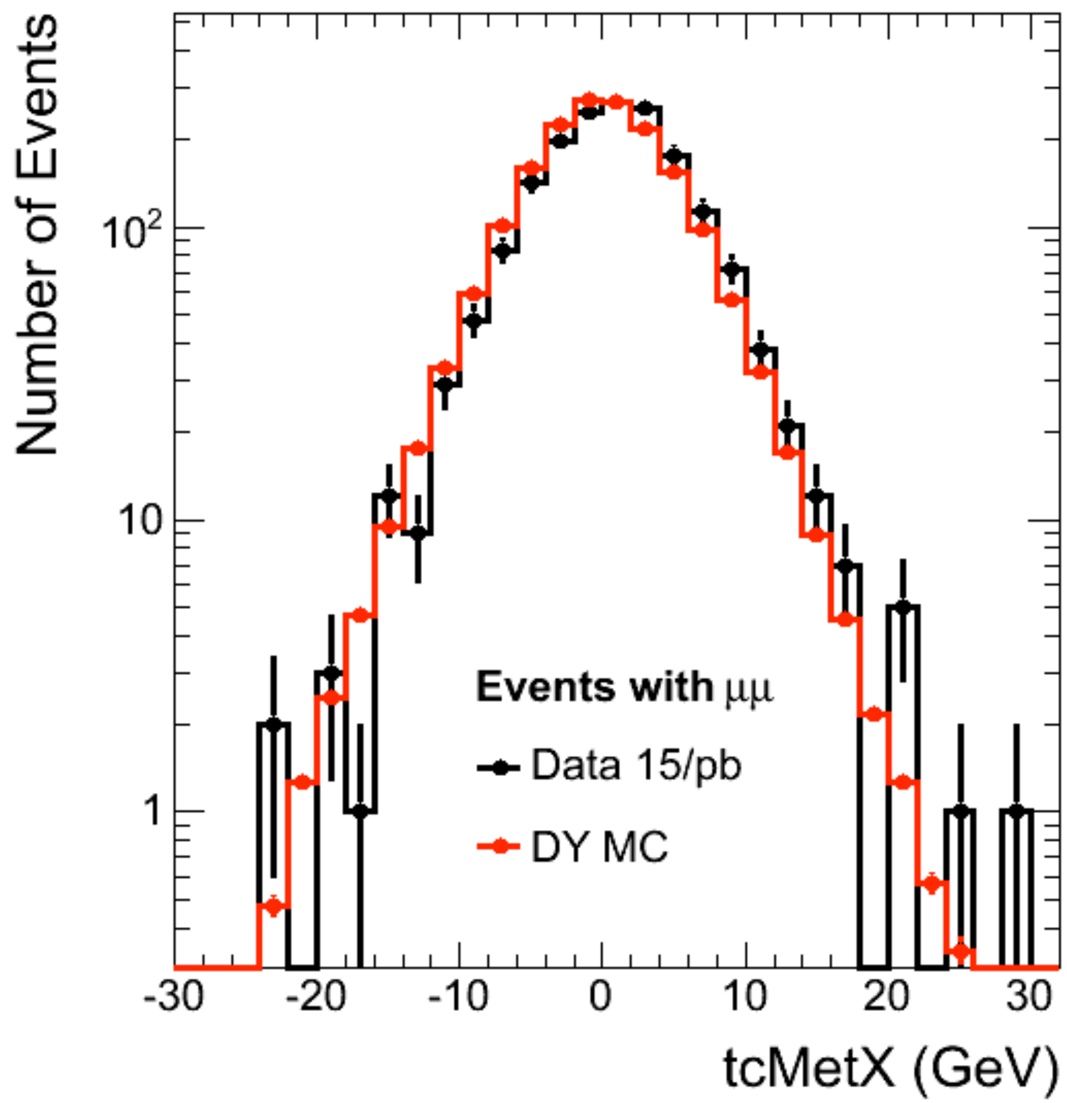
- Events with all number of vertices

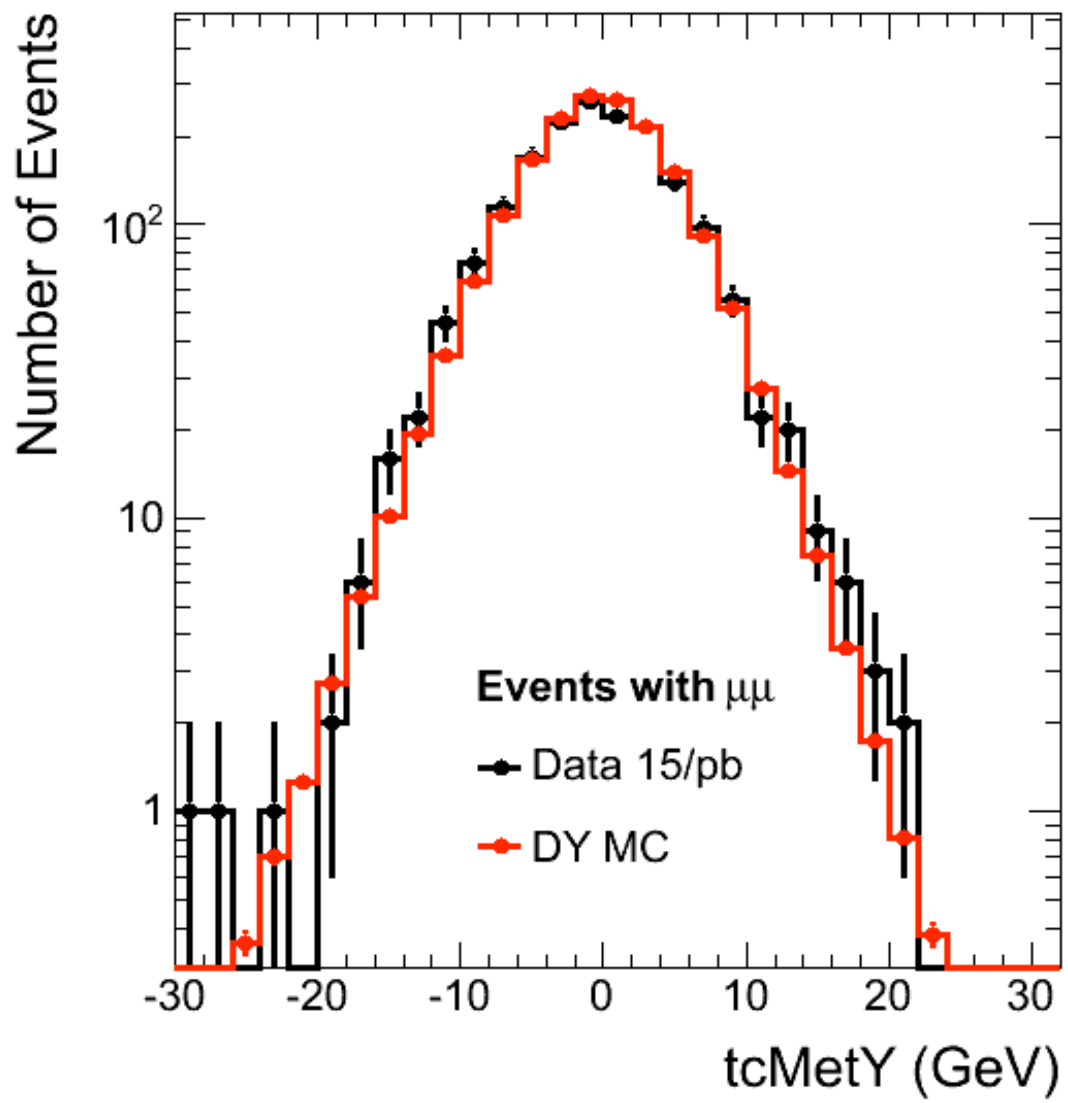




MET (x,y) in MM One-Vertex

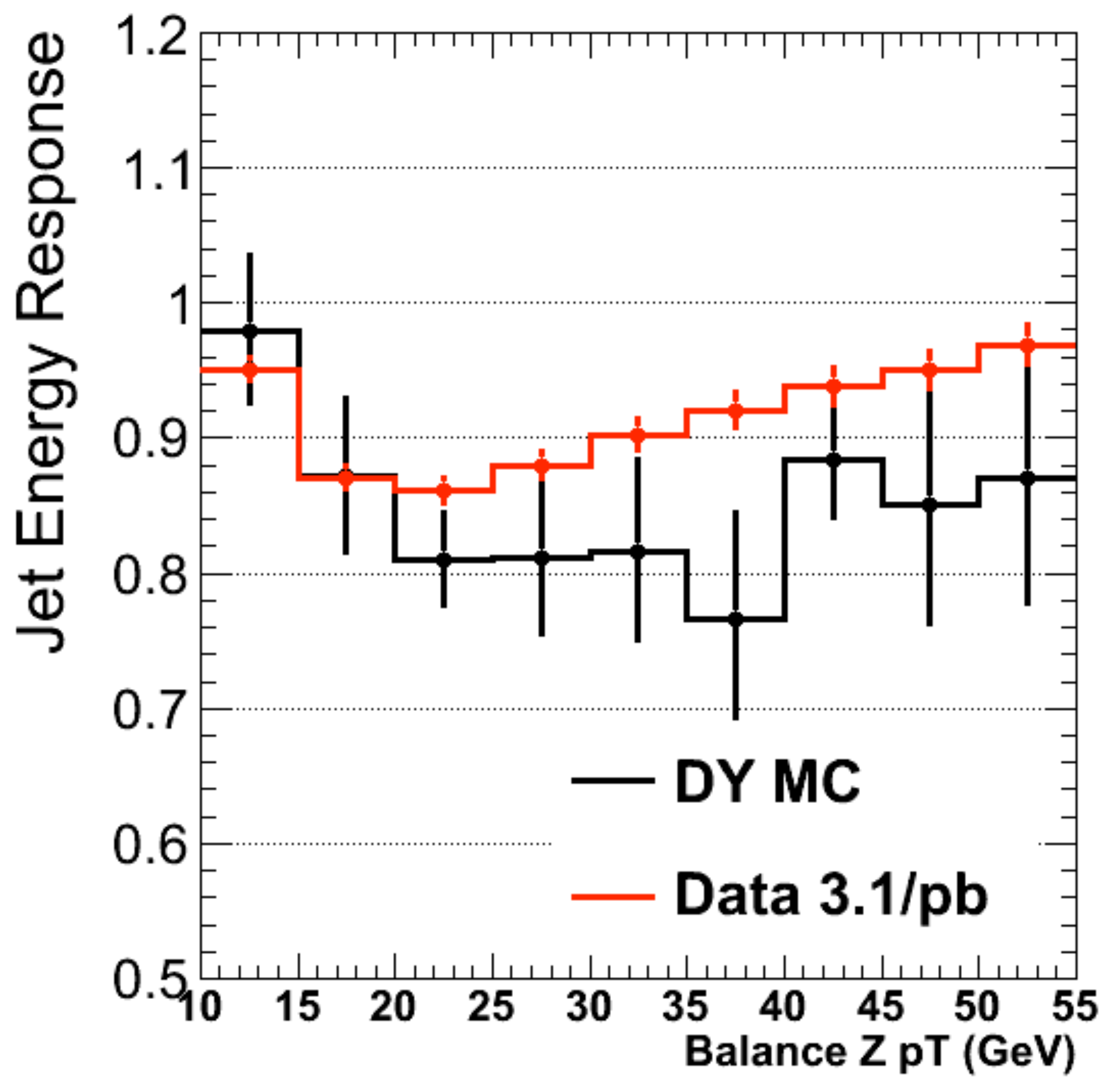
- Require only one good vertex in Data





Jet Energy Correction Using Z Balance (36X)

- The standard L2L3 JEC is derived for high pT jets, we need to cross-check the corrections in the region (20-30) GeV
- For this validation, we use Z+1 Jet events, with the selections,
  - |ΔΦ(leading jet-diLepton)-π|<0.2
  - Other jets in the event with pT < 0.1 * leading jet pT
- The jet response is defined as corrected leading jet pT / dilepton pT



1. There is an overall systematic difference in data vs MC, however data is statistically limited

2. Similar conclusion is found from γJets study, Francesco Pandolfi http://indico.cern.ch/getFile.py/access?contribId=0&resId=0&materialId=slides&confId=108390

3. Assume the 7% at 25GeV is real, we get ~2-3% additional uncertainty from JEC, this needs to be checked with more data